NAVAIR CBM+, EBM AND RCM OVERVIEW

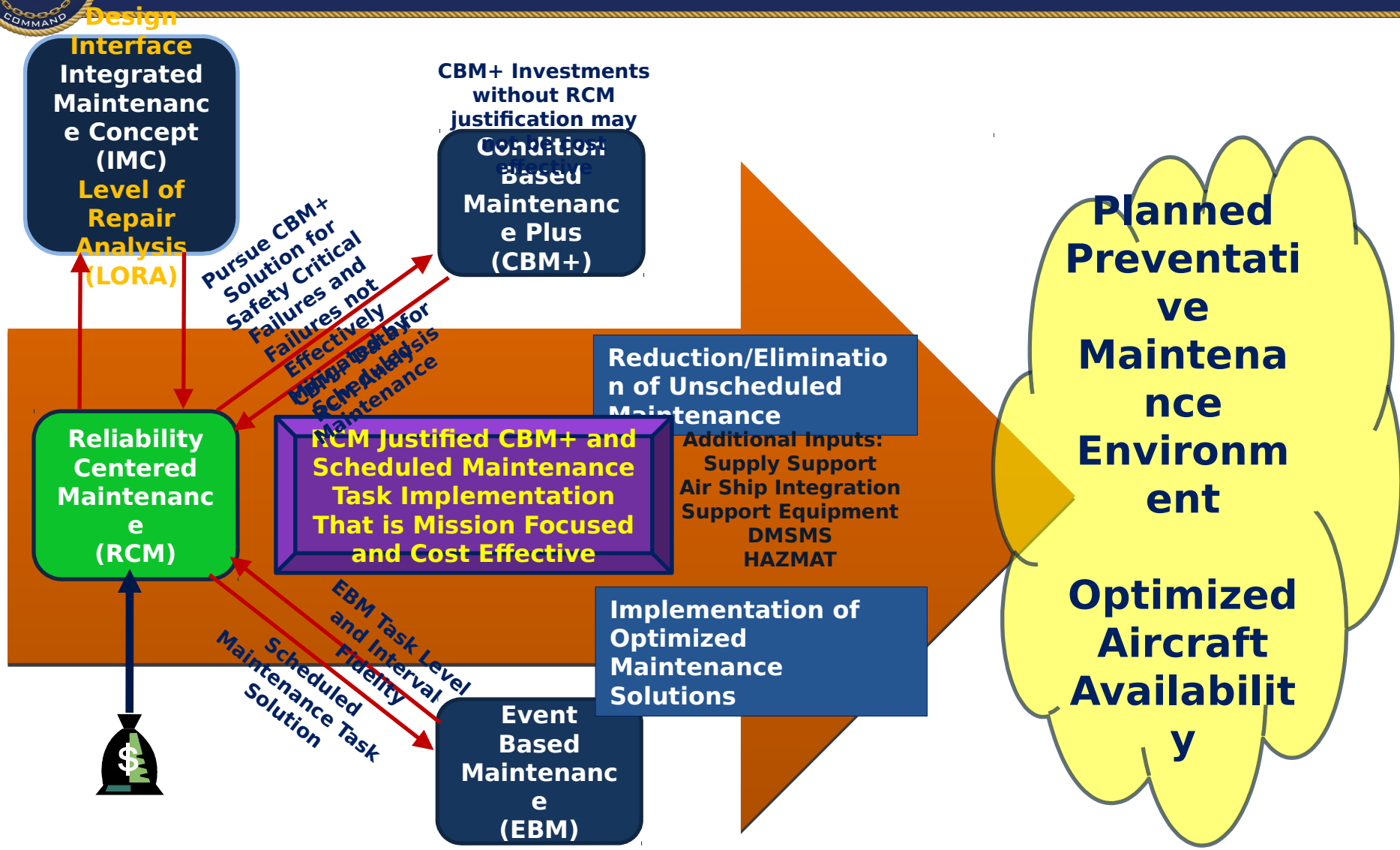
1 November 2011

Presented to:
RAM 4 Conference

Presented by:
Tony Kimberlin (AIR-6.7.1.3)

NAVAIR

NAVAIR Maintenance Planning Vision


Design Interface
Integrated Maintenance Concept (IMC)
Level of Repair Analysis (LORA)
CBM+ Investments without RCM justification may not be cost effective
Condition Based Maintenance Plus (CBM+)
Pursue CBM+ Solution for Safety Critical Failures and Failures not Effectively Mitigated by Scheduled Maintenance
Reliability Centered Maintenance (RCM)
RCM Justified CBM+ and Scheduled Maintenance Task Implementation That is Mission Focused and Cost Effective
Reduction/Elimination of Unscheduled Maintenance
Additional Inputs:
Supply Support
Air Ship Integration
Support Equipment
DMSMS
HAZMAT
Implementation of Optimized Maintenance Solutions
EBM Task Level and Interval Fidelity
Scheduled Maintenance Task Solution
Event Based Maintenance (EBM)
Planned Preventative Maintenance Environment
Optimized Aircraft Availability

RCM IS THE FOCAL POINT FOR INITIAL MAINTENANCE PLANNING INVESTMENTS AND DRIVES WHETHER A SOLUTION IS CBM+ OR A PREVENTATIVE SCHEDULED MAINTENANCE TASK

CBM+ WORKING GROUP AND DEMO PROJECT

NAVAIR Condition Based Maintenance Plus (CBM+) Working Group

Product Support Approach

- NAVAIR CBM+ Working Group formed to provide Enterprise-wide CBM+ solutions and policy
- Working Group comprised of members from AIR-4.3, 4.4, 6.7, 6.8, and NACRA to address CBM+ data architecture, data analysis tools, policy, documentation, and BCA development . (Tony Kimberlin (AIR-6.7.1.3) Working Group Lead. Dan Nega (AIR-6.8) NAVAIR CBM+ ESG Chair.)
- NAVAIR CBM+ WG focused on Proposed Demo Project with an H-53E squadron TBD to set up an end-to-end CBM+ construct in order to identify gaps, evaluate CBM+ tools, develop gov't owned data analysis tools and processes, develop data architecture and warehousing requirements, and establish CBM+ Enterprise policy
- CBM+ Demo will track 7 life limited and 5 health monitored components to develop CBM+ data analysis tools and processes

Collaboration

- Focus of NAVAIR CBM+ Working Group efforts is to evaluate and develop CBM+ tools and processes with internal government resources
- However the NAVAIR CBM+ Working Group intends to leverage existing CBM+ efforts to the greatest extent feasible. This will include leveraging CBM+ efforts (not limited to) the following:
  - NAVSEA/Carderock
  - Army
  - Program Offices
  - Industry
  - Academia

Sustainment Schedule

- CBM+ Working Group Demo Project – Present to Sept. 2013
  - Demo set up tasking – Present to Dec. 2011
  - Demo commencement – Mar. 2012 approx.
  - Demo completion – Mar. 2013 approx.
  - Post-demo analysis/evaluation – Mar. 2013 – Sept 2013 approx.
- CBM+ ALE Implementation – FY14/15
- CBM+ Policy Implementation – FY14
- CBM+ Data Analysis 'Tool Kit' – FY14

Outlook

Evolution of the NAVAIR CBM+ Working Group into a NAVAIR CBM+ Enterprise Team organization – formal charter

Expansion of CBM+ Demo project efforts to other T/M/S

CBM+ Working Group FY14 Effort Focused on Providing and Implementing CBM+ Automated Logistics Environment (ALE) Requirements

Preventative **Diagnostic** **Predictive** **Prognostic**

OBJECTIVES

- Increase Operational Availability
- Improve Flight Safety
- Improve Maintenance Efficiency
- Reduce Total Ownership Costs

CBM Enablers

- On-Board Systems (Sensors)
- Ground Based Systems (Flight Line Diagnostics)
- Data Management and Analysis System

Life Management

Main rotor sleeve
Spindle assembly
Main rotor lower hub plate
Main rotor upper hub plate
Main rotor shaft extender
Main gearbox housing
Main rotor shaft

Health Monitoring

Tail Rotor Drive Shaft Hanger Bearing Assembly
Main Rotor Head Pitch Control Rod and Damper Bearing
Main Gearbox Oil Cooler Blower Bearing Assembly
Intermediate Gearbox
Nose Gearboxes

Maximize Combat Power

A Day in the Life: CBM+ Future End State

- Open Source
- Impacts entire NAE and Industry
- Very Complex
- Disciplined Systems Engineering Approach

GBA

Data Transfer

Exceedances/Data Transfer

Health

Data Transfer

SAFE

Life Remaining Computations

Individual Aircraft

NAVAIR/OEM/ISST Engineering

Cost per Flight Hour

Total Ownership Cost

Data Transfer

NAVICP/DLA

OOMA

Requisitions

Deckplate/ Data Warehouse

IMD/Cost/Deckplate Data

Aircraft Health Feedback

Consumption

Forecast

Root Cause Analyses

RCM/Maintenance Planning

Updates

FRCs/OEMS

Workload

Repair Feedback

COE

Performance and Data

HQMC/N88/N43

Program Performance

Fleet of Aircraft

Sustainment Roadmaps

Courses of Action

Unit Performance

Forecasts

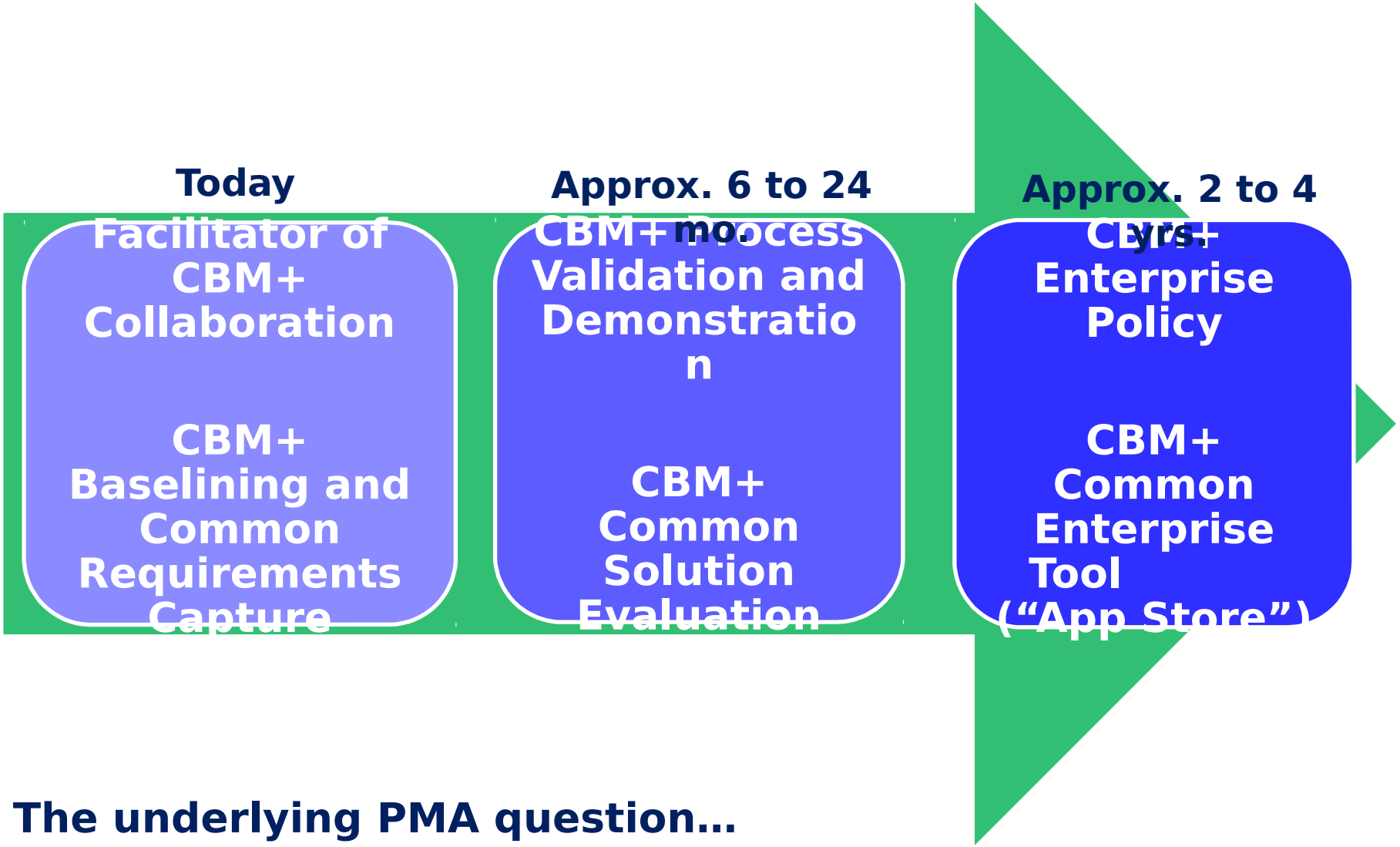
PEO

Data

ILSMS

Fleet Operators

NAVAIR CBM+ WG Vision


Today
Facilitator of CBM+ Collaboration
CBM+ Baselining and Common Requirements Capture
Approx. 6 to 24 mos.
CBM+ Process Validation and Demonstration
CBM+ Common Solution Evaluation
Approx. 2 to 4 yrs.
CBM+ Enterprise Policy
CBM+ Common Enterprise Tool ("App Store")

The underlying PMA question…
When does the CBM+ WG impact my CBM+ approach?

RCM, EBM AND THE NAVAIR MAINTENANCE PLANNING VISION

Reliability Centered Maintenance (RCM)

RCM Definition:

"RCM is an analytical process to determine the appropriate failure management strategies, including preventive maintenance requirements and other actions that are warranted to ensure safe operations and cost-wise readiness"-- NAVAIR 00-25-403

RCM Identification Steps:

(1) Function--The desired capability of the system, how well it performs, and under what circumstances

(2) Functional Failures--The failed state of the system

(3) Failure Modes--The specific condition causing a functional failure

(4) Failure Effects--Description of what happens when each failure mode occurs with consequences detailed

(5) Failure Consequences--The description of how the loss of function matters (e.g. safety, environmental, mission, or economics)

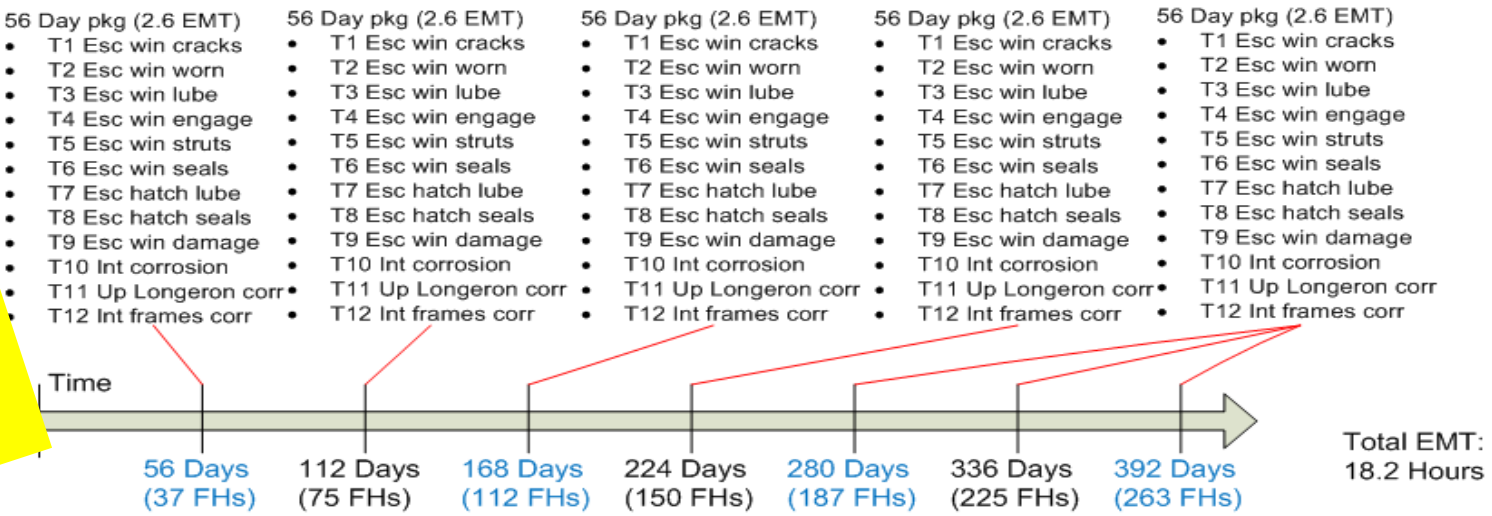
(6) Maintenance Tasks and Intervals--The description of applicable and effective tasks, if any, performed to predict or prevent failures

(7) Other Logical Actions--Run-to-failure, engineering

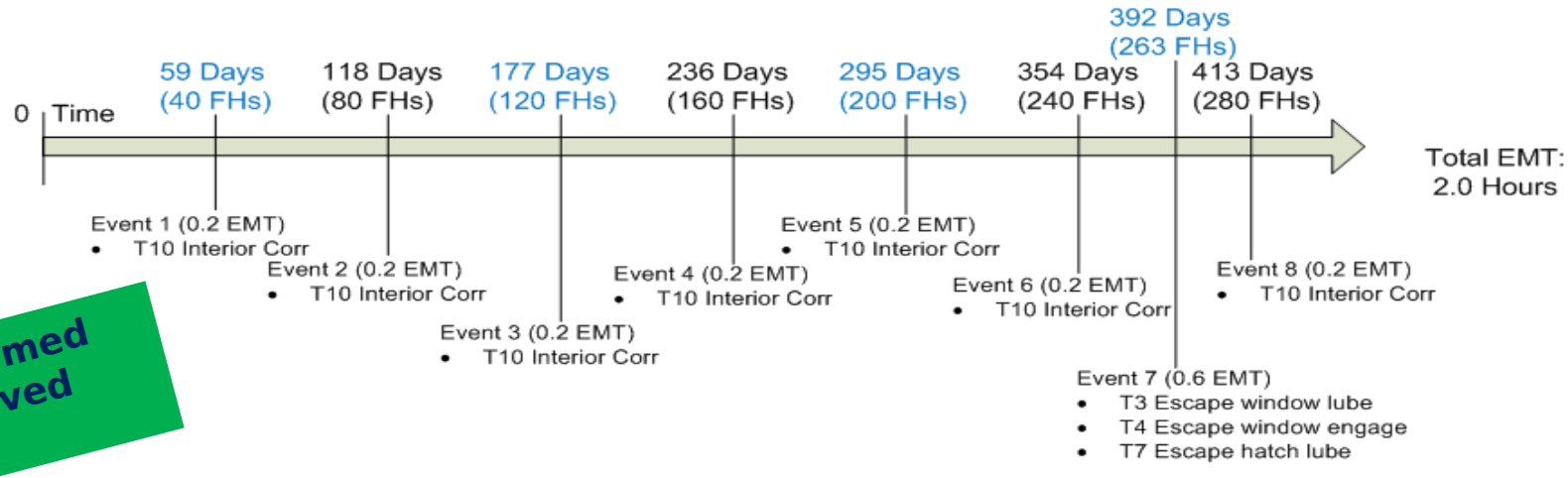
Event Based Maintenance (EBM) Illustrated

Traditional H-53E 56 Day Inspections

Tasks grouped by 56-Day package



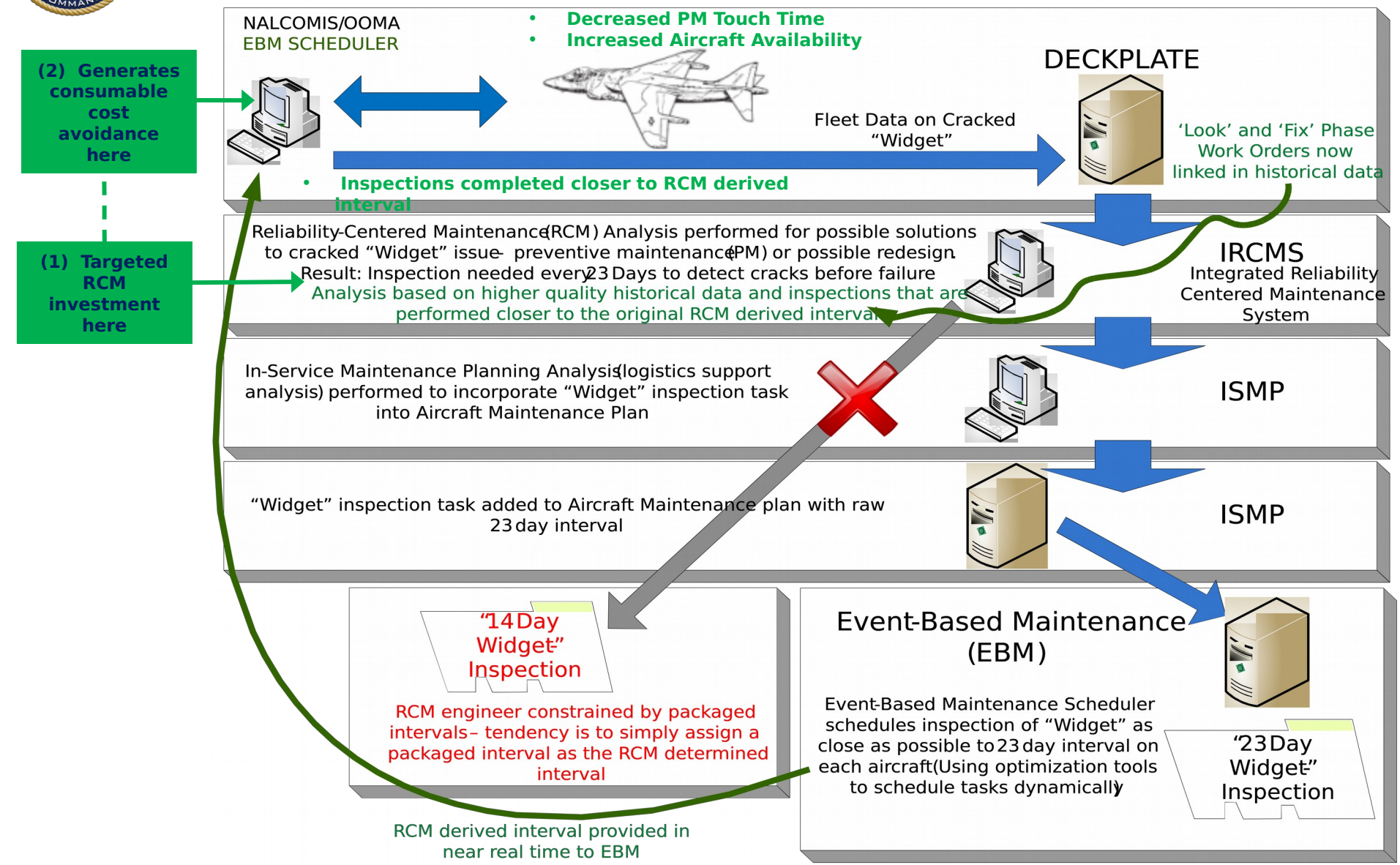
EBM Events **



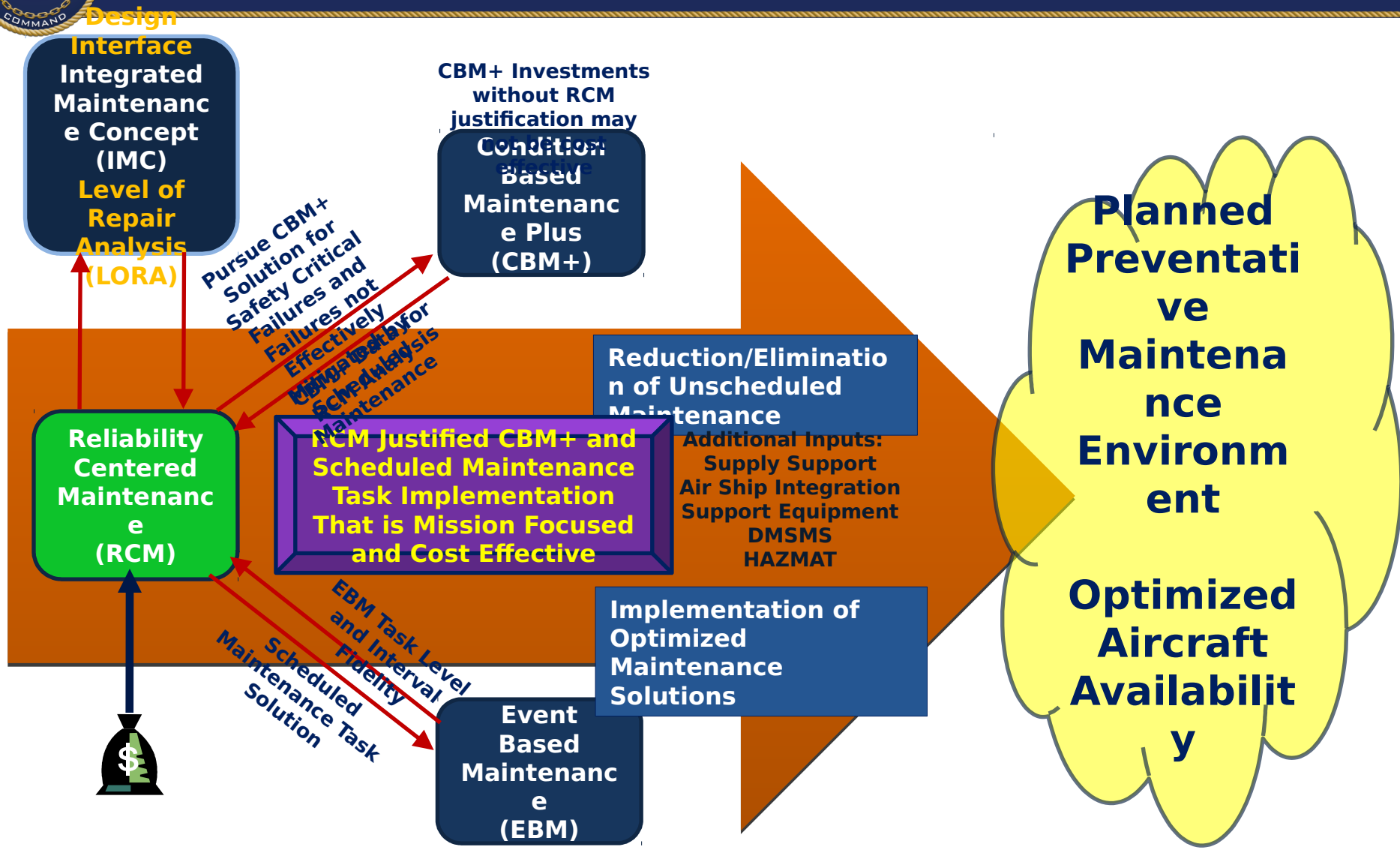
Tasks performed at RCM derived intervals

****EBM timeline depiction based on 2007 HM-15 Historic Squadron Flight Hours**

Reliability Centered Maintenance (RCM) and Event Based Maintenance


(2) Generates consumable cost avoidance here
(1) Targeted RCM investment here
NALCOMIS/OOMA
EBM SCHEDULER
• Decreased PM Touch Time
• Increased Aircraft Availability
DECKPLATE
Fleet Data on Cracked "Widget"
'Look' and 'Fix' Phase Work Orders now linked in historical data
• Inspections completed closer to RCM derived interval
Reliability-Centered Maintenance (RCM) Analysis performed for possible solutions to cracked "Widget" issue - preventive maintenance (PM) or possible redesign. Result: Inspection needed every 23 Days to detect cracks before failure
Analysis based on higher quality historical data and inspections that are performed closer to the original RCM derived interval
IRCMS
Integrated Reliability Centered Maintenance System
In-Service Maintenance Planning Analysis (logistics support analysis) performed to incorporate "Widget" inspection task into Aircraft Maintenance Plan
ISMP
"Widget" inspection task added to Aircraft Maintenance plan with raw 23 day interval
ISMP
"14 Day Widget" Inspection
RCM engineer constrained by packaged intervals – tendency is to simply assign a packaged interval as the RCM determined interval
Event-Based Maintenance (EBM)
Event-Based Maintenance Scheduler schedules inspection of "Widget" as close as possible to 23 day interval on each aircraft (Using optimization tools to schedule tasks dynamically)
"23 Day Widget" Inspection
RCM derived interval provided in near real time to EBM

NAVAIR Maintenance Planning Vision


Design Interface
Integrated Maintenanc e Concept (IMC)
Level of Repair Analysis (LORA)
CBM+ Investments without RCM justification may
Condition Based Maintenanc e Plus (CBM+)
Pursue CBM+ Solution for Safety Critical Failures and Failures not Effectively
Reliability Centered Maintenanc e (RCM)
RCM Justified CBM+ and Scheduled Maintenance Task Implementation That is Mission Focused and Cost Effective
Reduction/Eliminatio n of Unscheduled
Additional Inputs:
Supply Support
Air Ship Integration
Support Equipment
DMSMS
HAZMAT
Implementation of Optimized Maintenance Solutions
EBM Task Level and Interval Fidelity
Scheduled Maintenance Task Solution
Event Based Maintenanc e (EBM)
Planned Preventati ve Maintena nce Environm ent
Optimized Aircraft Availabilit y

RCM IS THE FOCAL POINT FOR INITIAL MAINTENANCE PLANNING INVESTMENTS AND DRIVES WHETHER A SOLUTION IS CBM+ OR A PREVENTATIVE SCHEDULED MAINTENANCE TASK

QUESTIONS